

Cunningham RADIO TUBES

C-239

SUPER-CONTROL R-F AMPLIFIER PENTODE

The '39 is a super-control pentode recommended for use primarily as a radio-frequency amplifier, intermediate-frequency amplifier and superheterodyne first detector in automobile receivers and in sets operated from d-c power lines. It has a heater-cathode which is designed for d-c operation. This feature together with that of general freedom from microphonic and battery circuit disturbances makes the '39 well suited to mobile service and other applications where complete d-c operation is desirable. The '39 is very effective in reducing cross-modulation and modulation-distortion over the usual range of signal voltages without the use of antenna potentiometers or auxiliary volume control switches. (See Super-Control feature, page 15). This super-control characteristic makes the tube uniquely adaptable to r-f and i-f stages of receivers employing automatic volume control.

The use of a **suppressor** is an important feature of the '39 because it permits variation in tube structure so as to obtain a high plate resistance without impairing other desired characteristics. In comparison with the usual type of screen grid tube operated under similar conditions, the '39 has a much higher plate resistance and a considerably increased range of voltage swing. Furthermore, a high value of mutual conductance is maintained.

The suppressor is connected inside the tube to the cathode. During operation of the tube, the suppressor eliminates the secondary emission effects which limit the voltage swing permissible in the usual screen grid tube at low plate voltage, that is, at a plate voltage approximately equal to the screen voltage. The suppressor in the '39, therefore, makes possible the efficient operation of this tube at a relatively low plate voltage. This may be greater than, equal to, or slightly less than the recommended screen voltage.

CHARACTERISTICS

Heater Voltage (D. C.)			6.3	Volts
Heater Current			0.3	Ampere
Plate Voltage	90*	135	180 *max.*	Volts
Screen Voltage (Maximum)	90	90	90	Volts
Grid Voltage (Minimum)	−3	−3	−3	Volts
Plate Current	4.4	4.4	4.5	Milliamperes
Screen Current	1.3	1.2	1.2	Milliamperes
Plate Resistance	375000	540000	750000	Ohms
Amplification Factor	360	530	750	
Mutual Conductance	960	980	1000	Micromhos
Mutual Conductance at −30 volts bias	10	10	10	Micromhos
Mutual Conductance at −40 volts bias	Very small but not zero			
Effective Grid-Plate Capacitance			0.007 *maximum*	μμf.
Input Capacitance			4.0	μμf.
Output Capacitance			10.0	μμf.
Overall Length				4 9/32" to 4 17/32"
Maximum Diameter				1 9/16"
Bulb (See page 42, Fig. 9)				S-12
Cap				Small Metal
Base				Small 5-Pin

* Recommended values for use in receivers designed for 110 volt d-c line operation.

INSTALLATION

The base pins of the '39 fit the standard five-contact socket. The socket may be

installed to hold the tube in any position. For socket connections, see page 39, Fig. 9.

The **heater** of the '39 is designed to operate satisfactorily from a 6-volt automobile storage battery without a rheostat or a fixed resistor, despite the voltage fluctuations during the charge and discharge periods. These variations in heater voltage do not seriously affect the performance or serviceability of this tube. The heater may be operated in series with the heaters of the '36, '37, or '38. This feature is especially desirable in receivers designed to operate from d-c house mains. Regardless of the number of heaters connected in series, the current in the heater circuit should be adjusted to 0.3 ampere for the normal supply voltage.

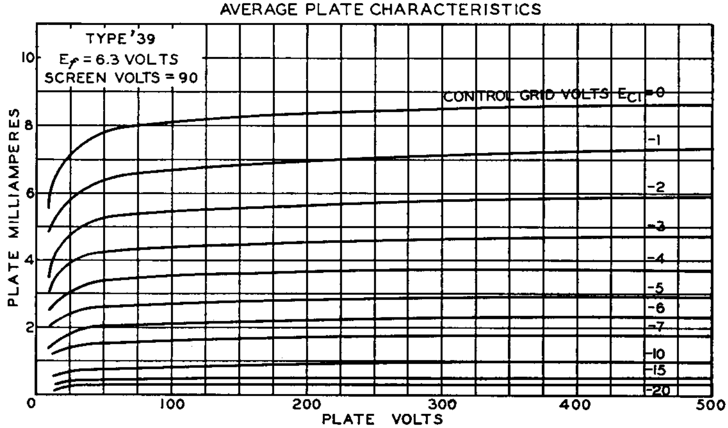
The **cathode** circuit in most d-c receivers is usually tied in either directly or through biasing resistors to the negative side of the heater circuit. The voltage difference thus introduced between heater and cathode should be kept as much as possible below the recommended maximum of 45 volts.

The positive **screen voltage** for the '39 may be obtained from a section of the B-battery, from a fixed or variable tap on a voltage divider across the supply voltage, or from a portion of the supply. Care should be taken to keep the impedance between the screen and cathode as low as possible.

When the '39 is self-biased, a resistor in series with the high voltage supply may be used for obtaining the screen voltage. This is possible because of the stable screen current characteristic of the '39 pentode. The resistor method of securing the screen voltage is limited to circuits where the screen voltage supply does not exceed 180 volts as a maximum. The value of this resistance should be such that under the conditions of minimum grid bias and maximum plate current the screen voltage will not exceed 90 volts. A resistance of approximately 80000 ohms will be suitable.

Complete **shielding** of all stages is necessary if maximum gain per stage is to be obtained.

AVERAGE PLATE CHARACTERISTICS



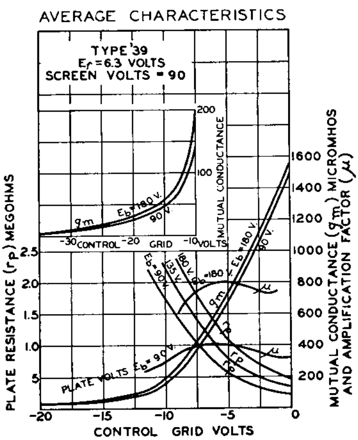
APPLICATION

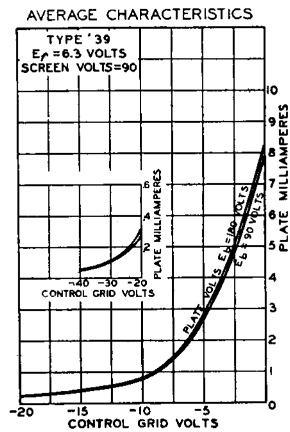
As a **radio-frequency** and **intermediate-frequency amplifier,** the '39 should be operated as shown under **CHARACTERISTICS.** In general, properly designed radio-frequency transformers are preferable to interstage coupling impedances, especially in cases where a high impedance B-supply may cause oscillation below radio frequencies.

Volume control of receivers designed for the '39 may be accomplished by variation of the negative grid bias of this tube. In order to obtain adequate volume control, an available grid bias voltage of approximately 45 volts will be required.

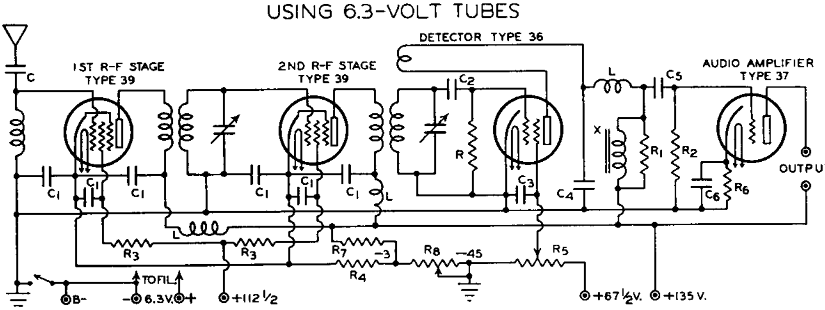
The exact value will depend upon the circuit design and operating conditions. This voltage may be obtained from a potentiometer, a bleeder circuit, a variable resistor in the cathode circuit, or from a separate source. *In any event, the heater to cathode bias for the '39 should not exceed 45 volts.*

As a **detector** working directly into an audio-frequency amplifier, the '39 is not ordinarily suited. However, it does have a very useful application as the first detector in superheterodyne circuits and may be utilized to advantage in that position. Suitable operating voltages for such service are: Plate voltage, 90 to 180 volts; screen voltage, 90 volts; grid voltage, −7 volts (approx.). With variable bias on the first detector, the peak oscillator voltage should be preferably about one volt less than the minimum grid bias (approximately 7 volts). This practice will eliminate the possibility of cross-modulation caused by the first detector drawing grid current. Without variable bias on the first detector, the oscillator peak voltage should be considerably less than the grid bias to prevent grid current on very strong signal voltage swings.





DIAGRAMMATIC SHORTWAVE RECEIVER
USING 6.3-VOLT TUBES



C = ANTENNA COUPLING CONDENSER (APPROX. 30 µµf.)
C_1 = R-F BY-PASS CONDENSER (0.01 µµf. TO 0.1 µµf.)
C_2 = GRID CONDENSER (0.00025 µµf.)
C_3 = R-F BY-PASS CONDENSER (1.0 µµf.)
C_4 = R-F BY-PASS CONDENSER (0.00025 µf.)
C_5 = COUPLING CONDENSER (.005 µf. TO 0.1 µf.)
C_6 = A-F BY-PASS CONDENSER (2 µf. TO 4 µf.)
L = R-F CHOKE (10 TO 50 MILLIHENRIES)
R = GRID LEAK RESISTOR (2 TO 5 MEGOHMS)

R_1 = COMPENSATING RESISTOR (0.25 MEGOHM)
R_2 = GRID COUPLING RESISTOR (1 MEG. MAX.)
R_3 = SCREEN DECOUPLING RESISTOR (30000 OHMS)
R_4 = MINIMUM BIAS RESISTOR (275 OHMS)
R_5 = REGENERATION CONTROL (50000 OHMS)
R_6 = SELF-BIASING RESISTOR (2000 OHMS APPROX.)
R_7 = BLEEDER RESISTOR (50000 OHMS, 2 WATT)
R_8 = VOLUME CONTROL (20000 OHM TAPER RESISTOR)
X = PLATE CHOKE (300 H. OR MORE)

NOTE: TYPES 56, 57 AND 58 MAY BE USED IN THIS CIRCUIT IN PLACE OF THE 37, 36 AND 39 RESPECTIVELY, PROVIDED THAT THEY ARE OPERATED AT THEIR RECOMMENDED HEATER, SCREEN, PLATE AND GRID BIAS VOLTAGES. THE SUPPRESSOR GRID OF THE 57 AND 58 SHOULD BE TIED TO THE CATHODE AT THE SOCKET.